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PATENT SPECIFICATION

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(54) CONSUMABLE WIRE

(71) We, INSTITUT ELECTROSVARKI IMENI E.O. PATONA AKADEMII NAUK UKRAINSKOI SSR, of ulitsa Gorkogo 69, Kiev, Union of Soviet Socialist Republics, a Corporation organized and existing under the laws of the Union of Sovient Socialist Republics, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to consumable wire.

Consumable wire according to the invention can advantageously be used in automatic and semiautomatic welding. Consumable wire according to the invention can also be used in surfacing, with consumable and nonconsumable electrodes, of structural elements made from various metals and alloys. The surfacing may be carried out in a shielding atmosphere. Consumable wire according to the invention may also be used as a filler material for brazing.

Prior art consumable wire comprises a metal body having grooves therein. The grooves contain additives for welding (i.e. fluxes). The grooves made in the metal body widen toward the exterior of the wire. The cross section of each groove has the shape of a triangle with its vertex inside the metal body.

In the prior art consumable wire, there is not reliable cohesion of the additives with the metal body. As a result, when the wire is wound on and unwound from a reel or when it is coiled and uncoiled and then pushed through flexible wire feed cables and current contact nozzles of welding apparatus, the additives tend to peel off from the metal body, causing interruptions in the feed of the additives. Interrupted feed of the additives adversely affects the stability of welding resulting in poor welds. In addition, particles of the additives which have fallen from the wire clog the wire feed cables and current contact nozzles, thus necessitating frequent replacement thereof.

Because each groove is wider near the exterior of the wire the area of contact of the metal body with the current contact nozzles is undesirably low causing the stability of the welding to be impaired. For the same reason, the prior art wire has undesirably high moisture absorbing capacity resulting in the welds becoming porous.

According to a known process for producing consumable wire, longitudinal grooves are formed on the exterior face of a metal body of plastic deformation and the grooves are then filled with additives for welding.

The grooves are formed by a tool having a tapered working tip. Due to the tapered working tip of the tool and the tendency of metal to shrink when subjected to the known process, the grooves have a wide opening angle. Thus the additives become loose in the grooves and eventually come out of the grooves, particularly when the wire is bent during preparatory operations and during welding.

The additives becoming loose and coming out renders it difficult to close the grooves by redrawing the wire because the charge which is normally highly abrasive contaminates the lubricant and causes the wire to break.

According to the present invention, there is provided consumable wire comprising a metal body and additives for welding, the metal body having one or more axially extending ducts formed in a peripheral portion thereof, the or each duct having a cross section which narrows towards the surface of the wire to zero at said surface, the additives being received in the duct or ducts.

An advantage of consumable wire according to the invention is that, due to

the shape of the ducts, the additives do not readily come out of the ducts when the wire is bent or pushed through wire feed cables.

Other advantages of consumable wire according to the invention over the prior art consumable wire are that, due to the or each duct narrowing to zero at the surface of the wire, an increased area of contact of the metal body with the current contact nozzles is possible and the wire has a lower moisture absorbing capacity.

The or each duct may be triangular in cross section, with the vertex of the triangle lying on the surface of the wire.

When the consumable wire is being bent, it is its portion adjacent to the surface (i.e. its peripheral portion) which is subject to tension and compression to the greatest extent. To provide for reliable retention of the additives within the duct or ducts, when the wire is of circular cross section, the or each duct should preferably have a depth equal to 0.3—0.7 of the wire radius and a maximum width equal to 0.3—0.8 of the radius.

The depth of the or each duct is preferably equal to 0.3 of the wire radius if the wire is to be subjected, in the course of operation, to bending through angle of at least 180°. If the wire bending angle lies between 150 and 90°, the depth of the or each duct is preferably equal to 0.4—0.6 of the wire radius. With bending angles less than 90°, the or each duct preferably has a depth equal to 0.7 of the wire radius. Further increase in the depth of the or each duct is not feasible since this will impair the strength of the wire and render the process of its fabrication more difficult. If the width of the or each duct is less than 0.3 of the wire radius the amount of additives that can be accommodated therein is undesirably low. If the width of the or each duct is made greater than 0.8 of the wire radius, the probability of a proportion of the additives falling out therefrom becomes undesirably high.

To impart high welding properties to the consumable wire and render the wire easy to manufacture, the overall cross-sectional area of the duct or ducts preferably amounts to 0.05 to 0.3 of the wire cross-sectional area.

The ratio of the overall cross-sectional area of the duct or ducts to the wire cross-sectional area is referred to herein as the duct area coefficient K_s. The right amount and compositionof additives, in most cases, are insufficient when K_s=0.05, and commercial production of the wire may become difficult if K_s=0.3.

When it is necessary to introduce into the wire, mainly, ionizing components, the coefficient K_s is preferably in the range of from 0.05 to 0.07. Should the need arise to introduce, for example, both ionizing and slag-forming components, K_s is preferably in the range of from 0.07 to 0.02.

In cases where jointly introduced into the wire are ionizing, slagforming, gas-forming, deoxidizing and alloying components, K_s is preferably in the range of from 0.2 to 0.3.

According to the invention there is also provided a process of producing wire according to the invention, comprising forming one or more axially extending grooves in the peripheral portion of a metal wire body by plastic deformation, squeezing the metal wire body radially, filling the one or more grooves with additives for welding and reducing the cross section of the or each groove at the surface of the wire to zero.

The radial squeezing of the wire reduces the opening angle of the or each groove thereby reducing the tendency of the additives to come out.

We refer to the grooves, when they have been closed, by reducing their cross sections at the surface of the wire to zero, as "ducts".

Preferably the reduction in cross section of the or each groove at the surface of the wire is effected by drawing the wire.

The invention is further described below with reference to the accompanying drawings, wherein:

Figure 1 is a perspective view of a consumable wire according to the invention;

Figure 2 is a view taken along line II—II of Figure 1;

Figures 3 to 5 are cross-sectional views of other electrode wires according to the invention;

Figure 6 is a diagrammatic view of apparatus carrying out a process according to the invention;

Figures 7 to 15 show metal wire bodies and consumable wire at various stages during production of consumable wire according to the invention;

Figure 7 is a cross-section view taken along line IX—IX of Figure 6 of a consumable wire body before the grooves have been formed therein;

Figure 8 is a view taken along line X—X of Figure 6, showing a consumable wire body with two grooves before the wire has been squeezed radially;

Figure 9 is a cross-section view of a consumable wire body with three grooves before the wire has been squeezed radially;

Figure 10 is a view taken along line XII—XII of Figure 6, showing a consumable wire body with two grooves after the wire has been squeezed radially by drawing through a die;

Figure 11 is a cross-section view of a

consumable wire body with three grooves after the wire has been squeezed radially;

Figure 12 is a view taken along line XIV—XIV of Figure 6 showing a consumable wire with two grooves filled with additives for welding, prior to drawing of the wire a second time;

Figure 13 is a cross-section view of a wire with three grooves filled with additives for welding, prior to drawing the wire a second time;

Figure 14 is a view taken along line XVI—XVI of Figure 6, showing a consumable wire with two ducts, after the wire has been drawn a second time; and

Figure 15 is a view taken along line XVIII—XVIII of Figure 6, showing a consumable wire according to the invention with two ducts after the wire has been drawn a third time.

Referring now to the drawings (Figures 1 to 15), the consumable wire 1 is of circular cross section and comprises a metal body and a composition of additives 2 for welding (Figures 1 to 5 and 15). Formed in a peripheral portion of the metal body are axially extending ducts 3 holding the additives 2.

Each duct 3 has a cross section shaped as a geometric figure narrowing towards the surface of the electrode wire.

The ducts 3 of the wire shown in Figure 2 are substantially triangular in cross section, a vertex of the triangle lying on the surface of the wire.

When the wire is being bent, subjected to tension and compression to the greatest extent is the peripheral portion of the wire. Therefore, to provide for reliable retention to the additives within the wire, the ducts have a depth equal to 0.3—0.7 of the wire radius, while the maximum width of each groove is equal to 0.3—0.8 of the wire radius.

In order to enhance the welding properties of the consumable wire and render it easy to manufacture, the overall duct cross-sectional area is equal to 0.05—0.3 of the cross-sectional area of the wire.

The consumable wire may be made with two or more ducts provided the total cross-sectional area of the ducts constitutes 0.05—0.3 of that of the wire.

In order to make the ratio of the duct cross-sectional area to that of the wire equals 0.05, the wire should preferably have one or two ducts, and in order to increase this ratio to 0.15—0.25, it should be made with two-three or three-four grooves, respectively.

Figures 1 and 2 show cross sections of wire with two grooves.

Figures 3, 4 and 5 show cross sections of wires with three, one and four grooves, respectively.

For an even distribution of the additives across the wire, the grooves are arranged symmetrically about the axis of the wire.

In producing consumable wire, longitudinal grooves 3 are formed along the surface of the wire by way of plastic deformation and the grooves are subsequently filled with additives 2.

Prior to filling the grooves with the additives 2 the wire body is squeezed radially so that the grooves acquire a cross section which narrows towards the surface of the wire.

The process of producing consumable wire is illustrated in Figure 6. As shown in Figure 6, a metal wire 1 with a round cross section (Figure 7) is fed from an unwinder comprising a support 4 (Figure 6) and a rotary drum 5, through straightening rolls 6, into a roll stand wherein channels 3 are formed by means of rolls 7.

As the wire 1 leaves the roll stand, the cross section of the wire 1 having the shape, for example, shown in Figure 8 (with two grooves) or Figure 9 (with three grooves), it is squeezed radially for which purpose the wire 1 is drawn, for example, through a die 8 (Figure 6).

As a result of squeezing, the grooves 3 acquire, in cross section, the shape of a geometric figure narrowing towards the side surface of the wire 1.

This is further illustrated in Figure 10 which shows a wire with two grooves and in Figure 11 which shows a wire with three grooves.

The above steps having been carried out, the wire 1 is fed into a cleaning device 9 (Figure 6) for process grease to be removed.

The thus cleaned wire 1 is then fed into an extrusion device 10 wherein the grooves 3 are filled with a pasty composition consisting of additives 2 for welding.

The wire 1 having its grooves 3 filled with the additives 2 is illustrated in Figures 12 and 13.

The process of filling the grooves is similar to that of squeezing the wire.

After the grooves 3 have been filled with the additives 2, excess additives are removed from the surface of the wire 1 by passing the wire 1 through the calibrated orifice of a steel nozzle 11 (Figure 6), then the wire 1 is directed into a drying oven 12.

After drying, the wire 1 (together with the additives) is drawn through a multiple drawing mill 13 and wound onto a reel 14.

Figures 14 and 15 show the wires 1 respectively after a second and third drawing in mill 13, whereby the cross sections of the grooves at the axially

extending surface of the wire are reduced to zero.

The process for producing consumable wire need not be conducted in a continuous flow. For example, the wire can be wound onto reels and kept thereon until a later time.

The consumable wire in accordance with the present invention exhibits high welding properties, is easy to fabricate, prevents additives for welding from coming out, and ensures stability of the welding process, hence, high quality of the welds. The most important advantage of this wire resides in its ability to minimize spattering (bringing it down to 2—3%) during carbon-dioxide-shielded welding.

As compared to other known wires comprising a metal base and additives for welding, e.g. flux-cored wires, the wire of the present invention is substantially easier to manufacture and uses cheaper materials.

WHAT WE CLAIM IS:—

1. Consumable wire comprising a metal body and additives for welding, the metal body having one or more axially extending ducts formed in a peripheral portion thereof, the or each duct having a cross-section which narrows towards the surface of the wire to zero at said surface, the additives being received in the duct or ducts.

2. Consumable wire as claimed in claim 1, wherein the or each groove is substantially triangular in cross-section, the vertex of the triangle lying on the surface of the wire.

3. Consumable wire as claimed in either preceding claim, the wire being of circular cross-section, wherein the depth of the or each duct is equal to 0.3—0.7 of the wire radius, while its maximum width is equal to 0.3—0.8 of the wire radius.

4. Consumable wire as claimed in any preceding claim, wherein the overall cross-sectional area of the duct or ducts constitutes 0.05—0.3 of the cross-sectional area of the wire.

5. A process for producing consumable wire according to claim 1, comprising forming one or more axially extending grooves in the peripheral portion of a metal wire body by plastic deformation, squeezing the metal wire body radially, filling one or more grooves with additives for welding and reducing the cross-section of the or each groove at the surface of the wire to zero.

6. A process according to claim 5, wherein the reduction in cross-section of the or each groove at the surface of the wire is effected by drawing the wire.

7. Consumable wire substantially as described herein above with reference to and as illustrated in Figures 1 and 2 or any of Figures 1 to 5 or 15 of the accompanying drawings.

8. A process as claimed in claim 5 substantially as described herein with reference to Figure 6 of the accompanying drawings.

9. Consumable wire produced by a process as claimed in any of claims 5, 6 and 8.

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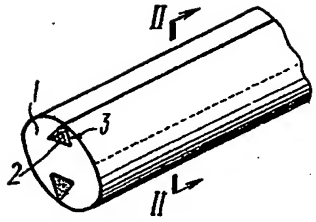

FIG. 1

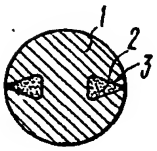

FIG. 2

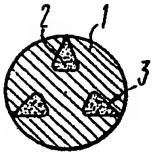

FIG. 3

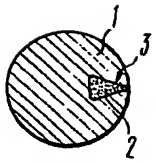

FIG. 4

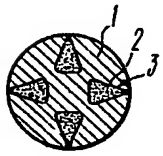

FIG. 5

1481140 COMPLETE SPECIFICATION
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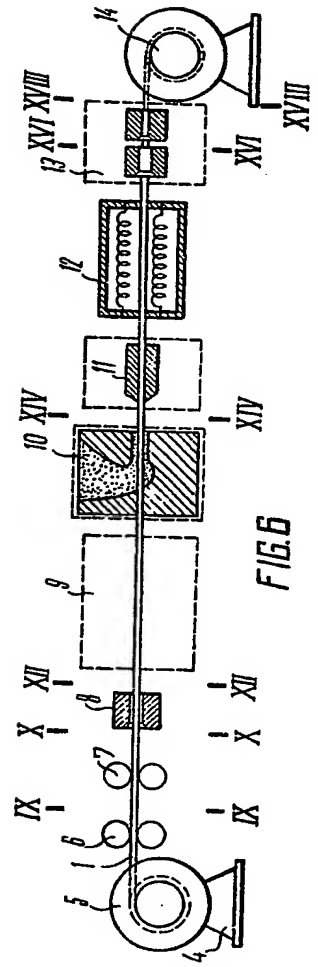

FIG.6

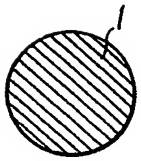

FIG. 7

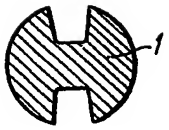

FIG. 8

FIG. 9

FIG. 10

FIG. 11

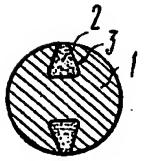

FIG. 12

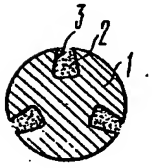

FIG. 13

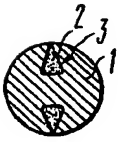

FIG. 14

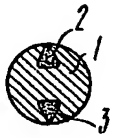

FIG. 15